preceding paper shows that so-called barometric waves sweep over the country in connection with thunderstorms. May they not also occur without thunderstorms? Such a case may be that of June 20, 1898, when the wave-like oscillations of the barometer at Williston, North Dakota, between 8 p. m. and midnight, were very remarkable and were repeated on the 22d, between 2 p. m. and 9 p. m., and again on the 23d between 4 p. m. and 8 p. m., although with diminished intensity. Notable disturbances are also found on nearly the same dates at the neighboring stations, Miles City, Mont., and Bismarck, N. Dak., but are barely visible on the barogram for Moorhead. (See Chart XII*b*, on which the barograms are reproduced.)

The general weather maps of 8 p. m. June 20, and 8 a. m. June 21, show that an area of low pressure, with southeast winds, was passing eastward over this region of the country, followed by high pressure with northwest winds.

The daily journals of the stations are as follows:

Williston, N. Dak., June 20, 1898.—Clear weather with light to fresh southeast winds; thunderstorm began at 8:50 p. m., ended during night.

June 22, 1898.—Partly cloudy; rain began and ended during night of 21st; began again at 9:30 a. m.; ended 10:20 a. m.; total, 0.12 inch; light northwest to southeast winds.

June 23, 1898.—Cloudy; rain began and ended during night; began again 8:30 to 9:25 a. m., 10:20 to 10:40 a. m.; began 5 p. m. and continued; total, 1.11 inch; wind fresh from the north.

Miles City, Mont.—The station agent in charge of this station does not keep a daily journal, but he has entered the word "thunderstorm" against the 8 p. m. observation of the 20th, thus indicating that such a storm was in progress at that time.

Bismarck, N. Dak., June 20, 1898.—Continued hot weather; maximum temperature, 95°, minimum, 70°; barometer falling steadily and slowly; temperature above 90° most of the afternoon, and only for a high, southerly wind the heat would have been oppressive; but an occasional cloud to be seen during the day, and there was none at all just before sunset, but soon after a heavy bank of clouds appeared in the southwest horizon and rose steadily, accompanied by almost incessant lightning, followed by a thunderstorm; first thunder heard at 11:48 p. m. and continued; maximum wind velocity, 30 miles.

June 21, 1898.—Thunderstorm continued; loudest thunder heard at 12:53 a. m.; rain began at 12:15 a. m. and ended during night, being heavy for a short time after it began. The day was warm, but not so warm as yesterday, with a light, southerly wind shifting to northwest, and slight changes in barometer; the wind attained a maximum velocity of 34 miles from the southwest soon after midnight; the rainfall during the thunderstorm amounted to 0.45 inch; lightning in the eastern horizon began early in the evening and continued.

June 22, 1898.—Heavy thunderstorm began during night, no data; rain began during night, and ended at 8:10 a. m., followed by cloudy and threatening weather and another thunderstorm; first thunder heard at 12:14 p. m.; loudest at 12:16 p. m.; storm came from the southeast and moved toward the north; temperature before the storm, 76°; after, 78°; direction of wind before the storm, east; after, southeast; no hail nor maximum wind velocity; light rain began at 12:20 and ended at 12:36 p. m.; amount, 0.02. The day was partly cloudy and threatening for the greater portion of the time, with slightly lower temperature and stationary barometer, and fresh, generally easterly winds; lightning in the eastern horizon in the early evening.

Havre, Mont.—The barogram shows no disturbances in pressure on the 20th corresponding to those observed at Williston. It does show, however, marked oscillations of the barometer in connection with a thunderstom twenty-four hours earlier. The observer's journal on the 20th follows:

June 20, 1898.—Cloudy at 11:00 a. m.; rain began at 11:59 a. m. and ended at 5:10 p. m.; clearing at 5:30 p. m.; clear at 6:00 p. m.; partly cloudy day and cooler.

The reports of voluntary observers between Williston and Bismarck do not show, as a rule, the beginnings and endings of rainfall or thunderstorm and it is, therefore, impossible to trace the Williston storm southeastward toward Bismarck, or, in fact, in any direction, so far as could be discovered. This is perhaps not surprising in view of the paucity of observing stations in the vicinity of Williston, the nearest one being about 50 miles distant.

Moorhead, Minn. (about 200 miles due east of Bismarck), June 20, 1898.—Partly cloudy in the morning soon clearing; the day was very warm, with fresh to brisk southeast wind; maximum temperature, 90°.

June 21, 1898.—The day was partly cloudy, with fresh to brisk and high wind; maximum, 34, southeast at 12:45 p. m.; thunder at 11:20 p. m.; storm reported on 22d.

June 22, 1898.—Thunderstorm; thunder first heard at 11:20 p. m. of the 21st; loudest at 12:20 a. m.; last about 3:00 a. m.; the storm came from the southwest and moved toward the northeast; temperature before the storm, 71°; after, 63°; direction of wind before the storm, southeast; after, southeast; rain began 12:05 a. m.; ended during night, amount at 8:00 a. m., 0.10 inch; high wind in the early morning, maximum 35 southeast at 12:45 a. m.; wind continued brisk southeast. Thunderstorm (2d); thunder first heard, 3:55 p. m.; loudest, 4:40 p. m.; last, 5:10 p. m.; the storm came from the southeast and moved toward the northeast; temperature before the storm, 82°; after, 68°; direction of wind before the storm, southeast; after, southeast; no hail at station; rain began 4:40 p. m., ending 5:10 p. m.; total 24-hour rainfall, 0.14 inch.

Summarizing the foregoing by dates, we find that on the 20th thunderstorms occurred at Williston (latitude, 48° 9′ N.; longitude, 103° 35′ W.), Miles City (latitude, 46° 25′ N.; longitude, 105° 49′ W.), and Bismarck (latitude, 46° 47′ N.; longitude, 100° 38′ W.), beginning at 8:50, 7:55, and 11:48 p. m., respectively. The curves of each barogram, while differing among themselves in their sinuosities, all show a more or less marked disturbance of pressure about the time the thunderstorms began. The fact that the thunderstorm at Bismarck did not begin until about four hours after the one at Miles City suggests that after all there may have been a continuous line of thunderstorm development between the two places.

21st.—The thunderstorm of the 21st continued at Bismarck, but there were no thunderstorms or perturbations in the barograms at the remaining stations, if we except two small drops in the Moorhead curve about ten and fifteen hours after the principal drop at Bismarck.

22d.—The Williston observer reports that a rainstorm began during the night; the Bismarck observer, a heavy thunderstorm. Both barograms show marked oscillations of pressure beginning at 1 a. m. at Williston, and shortly before 2 a. m. at Bismarck. As the distance between the two stations is about 160 miles it seems evident that in this case there was no actual propagation of an atmospheric wave from the one station to the other. The Moorhead barogram shows a pressure oscillation very shortly before 11 p. m. of the 21st, and the observer reports a thunderstorm at 11:20 p. m., continuing until 3 a. m. of the 22d. Thunderstorms were, therefore, apparently in progress simultaneously at two of the stations and a rainstorm at the third.

ARE OUR WINTERS CHANGING?

By ALFRED J. HENRY.

The frequency and severity of the cold waves that have visited the southern portion of the United States in late years, and the fact that the present winter season began much earlier than usual have led a number of people to make inquiry as to what are the reasonable expectations for the future? Is it probable that a more or less permanent change in the character of the winters has taken place? This problem is important since it involves a possible readjustment of present economic conditions. It is not new, nor is it any nearer a clear and definite solution than it was fifty years ago. According to the trend of the best thought of to-day the climate is not perceptibly changing. The mean temperatures obtained by the earliest instrumental observations, both in this country and abroad, show no differences greater than might reasonably be due to the character of the instruments used and their environment. The yearly means for a single station do not show a steady increase in heat culminating in a period of high temperature and then gradually receding

toward a period of diminished heat, but rather an irregularity in the distribution of warm and cold years that suggests at once the absence of any system of compensation or any gradual progression from one extreme to the other. Studies of annual means, when broadened to include those from a number of stations scattered over the globe are not devoid of interest, though perhaps they have not as yet yielded results of immediate practical importance.

For the States bordering the Gulf and South Atlantic coasts continuous instrumental records of the temperature previous to 1870 are lacking, although a number of broken series are available. The degree of cold experienced before that date is naturally a matter of considerable uncertainty, and while we may form a general idea of the relative severity of the winters, we are prevented from making as full an examination of the matter as its importance demands.

Taking Florida as a concrete illustration, we find that at least four very disastrous freezes have occurred within the one hundred years ending with 1898. We are inclined to the opinion that the first one, viz, that of 1835, was the most severe. The State then escaped further visitation for a period of fifty-one years, or to January, 1886. The next period of immunity was comparatively brief, viz, seven years, or to December, 1894. Within two months of the last-named date, a second disastrous freeze occurred and there have been a number of dangerously low temperatures since.

The impression that the climate is changing is partly due to the fact that in recent times an account of every severe frost and freeze that occurs in the South is sent broadcast to all parts of the country, whereas, during earlier times no record was preserved except of the very severe freezes. This very lack of information respecting the earlier minor freezes prevents us in a measure from asserting in a more positive manner a rule of climate that appears to be common to all parts of the United States, viz, that periods of great refrigeration generally extend over several years. In support of this assertion, as affecting Florida, reference is made to the fact that the great freeze of 1835 was preceded by two severe winters, 1830–31 and 1831–32, and was immediately followed by a winter of more than average severity, 1836. The freeze of 1886 was preceded by a cold spell in January, 1884 (minimum at Jacksonville 21°), and the temperature fell to 22° at Jacksonville in January of 1887. The two freezes of the winter of 1894–95 were preceded by a cold wave in 1893, in which temperature fell to 24° at Jacksonville. All of this would seem to indicate, as above stated, that cold years are likely to be followed by years of similar character separated by one or more warm years, the complete cycle of events extending over from four to seven years; but we should not forget that this conclusion is not based on sufficient data to establish it firmly.

OBSERVATIONS AT RIVAS, NICARAGUA.

The records contributed for many years by Dr. Earl Flint, at Rivas, Nicaragua, include barometric readings. His present station is at 11° 26′ N., 85° 47′ W. The observations at 7:17 a. m., local time are simultaneous with Greenwich 1 p. m. The altitude of his barometer is 36 meters above sea level, but until the barometer has been compared with a standard it seems hardly necessary to publish the daily readings. The wind force is recorded on the Beaufort scale, 0–12. When cloudiness is less than $\frac{1}{10}$, the letter "F," or "Few," is recorded.

This station is situated on the western shore of Lake Nicaragua, not far from the eastern end of the western division of the Nicaragua Canal. The volcano Ometepe, on an island in Lake Nicaragua, is about 10 miles northeast of the station. Mr. Flint's records occasionally mention the presence of clouds in the early morning on the summit of this mountain.

Observations at Rivas, Nicaragua, November, 1898.

OBSERVATIONS AT 7:17 A. M. LOCAL (8 A. M. EASTERN STANDARD) TIME.

Date.	Temperature. Air.	Temperature. Dew-point.	Wind. Direction.	Wind. Force.	Upper clouds. Kind.	Upper clouds. Amount.	Upper clouds. Direction from.	Lower clouds. Kind.	Lower clouds. Amount.	Lower clouds. Direction from.	Daily rainfall.
	°	°									
1	72	68	nw.	0	cs.-ck.	10	se.	.....	.....	.....	0.00
2	71	68	nw.	0	ck.	6	ne.	.....	.....	.....	0.00
3	72	69	nw.	0	cs.	10	se.	.....	.....	.....	0.00
4	74	71	se.	0	.....	.....	.....	k.	10	se.	0.06
5	77	73	se.	1	.....	.....	.....	ks.	Few	se.	0.00
6	78	74	ne.	1	cs.	1	ne.	.....	.....	.....	0.00
7	76	73	ne.	1	cs.	3	se.	.....	.....	.....	0.10
8	77	72	ne.	1	.....	.....	.....	k.	Few	ne.	2.76
9	77	74	ne.	1	.....	.....	.....	k.	10	ne.	0.04
10	77	72	ne.	2	cs.	5	se.	k.	5	ne.	0.04
11	77	74	ne.	1	c.	2	sw.	k.	2	ne.	1.23
12	77	75	ne.	0	cs.	8	e.	k.	8	ne.	1.77
13	75	74	ne.	2	.....	.....	.....	ks.	10	ne.	0.69
14	76	72	ne.	1	c.	5	se.	k.	5	ne.	0.00
15	76	74	ne.	2	.....	.....	.....	ks.	10	ne.	0.37
16	76.5	71	ne.	1	ck.	2	ene.	.....	.....	.....	0.33
17	76	73	ne.	3	.....	.....	.....	ks.	9	ne.	0.00
18	76	73	ne.	0	cs.	1	ne.	.....	.....	.....	0.00
19	76	73	ne.	2	cs.	3	ne.	.....	.....	.....	0.13
20	76	70	ne.	2	.....	.....	.....	ks.	10	ne.	0.00
21	76	73	ne.	2	.....	.....	.....	k.	Few	ne.	0.00
22	76	73	ne.	2	.....	.....	.....	k.	2	ne.	0.00
23	76	71	ne.	1	.....	.....	.....	k.	7	ne.	0.00
24	76	73	ne.	1	.....	.....	.....	k.	Few	ne.	0.00
25	76	72	ne.	2	c.	Few	se.	ks.	Few	ne.	0.00
26	76.5	73	ne.	1	.....	.....	.....	k.	Few	ne.	0.00
27	78	74	ne.	2	.....	.....	.....	ks.	10	ne.	0.86
28	77	73	ne.	1	.....	.....	.....	ks.	10	ne.	0.31
29	77	73	ne.	2	cs.	Few	ne.	k.	Few	ne.	0.00
30	76	71	ne.	3	cs	Few	ne.	ks.	Few	ne.	0.00
Sums	...	.....	.....	.....	.....	.....	.....	.....	.....	.....	8.19
Means	75.9	...	.....	.....	.....	.....	.....	.....	.....	.....	.....

Rainfall nearly twice the normal for November.

OBSERVATIONS AT 8:43 P. M. SEVENTY-FIFTH (8 P. M. LOCAL) TIME.

Date.	Temperature. Air.	Temperature. Dew-point.	Wind. Direction.	Wind. Force.	Upper clouds. Kind	Upper clouds. Amount.	Upper clouds. Direction from.	Lower clouds. Kind.	Lower clouds. Amount.	Lower clouds. Direction from.
	°	°								
1	75	72	w.	0.5	cs.-ck.	10	{nw. se.}	.....	.....	.....
2	76	73	nw.	0	cs.	10	nw.	.....	.....	.....
3	77	73	nw.	0	{c. ck.}	10	{sw. ne.}	.....	.....	.....
4	80	76	se.	1	c., ck.	6	se.	.....	.....	.....
5	79	75	se.	0	.....	.....	.....	ks.	10	.....
6	81	77	se.	1	ck.	10	se.	.....	.....	.....
7	80	76	se.	2	cs.	10	se.	.....	.....	.....
8	78	77	se.	0	.....	.....	.....	k.	10	.....
9	78	75	se.	1	.....	.....	.....	k.	10	.....
10	78	75	e.	0	.....	.....	.....	k.	10	se.
11	77	74	se.	0	.....	.....	.....	k.	10	se.
12	77	76	ne.	1	.....	.....	.....	n.	10	ne.
13	77	74	ne.	1	.....	.....	.....	n.	10	.....
14	78	74	ne.	1	.....	0	.....	.....	0	.....
15	78	74	ne.	2	.....	.....	.....	ks.	10	ne.
16	77	73	ne.	2	.....	.....	.....	ks.	5	ne.
17	77	74	ne.	0	.....	.....	.....	ks.	10	ne.
18	78	74	ne.	0	.....	.....	.....	ks.	10	ne.
19	78	72	e.	1	ck.	8	e.	.....	.....	.....
20	77	73	ne.	2	c.	Few	ne.	.....	.....	.....
21	79	73	e.	1	cs.	Few	e.	.....	.....	.....
22	78.5	75	e.	0	.....	0	.....	.....	0	.....
23	80	74	e.	0	.....	0	.....	.....	0	.....
24	78	73	ne.	1	.....	.....	.....	k.	6	ne.
25	79	75	ne.	1	.....	.....	.....	k.	9	ne.
26	79.5	75	e.	1	.....	.....	.....	k.	10	e.
27	77	74	se.	1	.....	.....	.....	k.	10	se.
28	76	73	e.	0	c.	7	e.	.....	.....	.....
29	78	74	ne.	2	cs.	8	ene.	.....	.....	.....
30	78	72	ne.	2	.....	.....	.....	ks.	9	ne.
Means	78.3	.....	.....	.....	.....	.....	.....	.....	.....	.....

MEXICAN CLIMATOLOGICAL DATA.

Through the kind cooperation of Señor Mariano Bárcena, Director, and Señor José Zendejas, vice-director, of the Central Meteorologico-Magnetic Observatory, the monthly summaries